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The mesospheric metal layer topside: a possible connection to meteoroids

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Abstract. In the past, many studies have been carried out to demonstrate the influence of meteoroids on the atmospheric metal layer, observed roughly in the altitude range 80–105 km. Even with the capability of present day resonance lidars to measure metal densities within single meteor trails, it has been difficult to prove any influence of meteors on the average metal layer. In contrast to approaches taken earlier, we discuss here the seasonal characteristics of potassium, calcium, calcium ion, iron and sodium above 110 km altitude where the average nocturnal densities are so low that the existence of a baseline level of metal atoms and ions is often overlooked. By comparing simultaneous and common-volume observations of different metal layers at one location, we demonstrate that despite their different seasonal characteristics at lower altitudes remarkably similar seasonal characteristics are observed at higher altitudes. In addition, a qualitative agreement is also found for potassium at different latitudes. A comparison of metal densities at 113 km altitude with known meteor showers indicates a strong influence of shower meteoroids on the topside of the metal layers. Simultaneous observations of K along with Ca, Fe and/or Na permit the calculation of abundance ratios, which at 113 km altitude are quite similar to values measured in single meteor trails by ground based lidars. Furthermore, the increase in densities throughout summer is strong evidence for the influence of sporadic meteoroids on the high metal layers. This increase correlates well with the seasonal variation of sporadic micrometeor input independent of meteor showers. Given these evidences, we contend that there is a direct influence of ablating meteoroids on the topside of the mesospheric metal layer.

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